PATENT APPLICATION
Atty Docket: P56592 (P9943)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S):	Eung-Seok ROH	**EXAMINER:**
SERIAL NO.:	10/025,796	**ART UNIT:**
FILED:	December 26, 2001	
FOR:	**DYNAMIC HOST CONFIGURATION PROTOCOL SPOOFING IN POINT-TO-POINT PROTOCOL OVER ATM USING A xDSL MODEM**	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

37 C.F.R. § 1.131 DECLARATION OF PRIOR INVENTION MADE IN THE REPUBLIC OF KOREA TO OVERCOME CITED PATENT PUBLICATION

Sir:

I, Eung-Seok ROH, hereby declare that:

1. I am an inventor for the above-referenced patent application, which claims priority to U.S. provisional application number 60/316,282 that was filed with the U.S. Patent and Trademark Office on September 4, 2001.

2. This declaration is submitted to establish reduction to practice of the invention of the above-referenced patent application in Republic of Korea prior to August 23, 2001, which is the effective filing date of U.S. Patent Application No. 2003/0055990, which was filed by *Cheline*, and which was cited by the Examiner in the above-referenced patent application.

3. To establish the date of reduction to practice of the invention of the above-referenced patent application, the following documents are attached hereto and are submitted as evidence:

   a. Exhibit A is an invention disclosure document;

   b. Exhibit B is a certified translation of Exhibit A; and

   c. Exhibit C is a certified translation of U.S. provisional application number 60/316,282 that was filed with the U.S. Patent and Trademark Office on September 4, 2001.

4. The invention disclosure document provided as Exhibit A hereto was completed at least by August 23, 2001, which is earlier than the effective filing date *Cheline*.

5. The invention disclosure document and the translation thereof, provided as Exhibits A and B, respectively, to this Declaration show a reduction to practice of the invention claimed in the above-referenced patent application.

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6. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statement may jeopardize the validity of the application or any patent issuing thereon.

Date: 24/06/2004

Eung-Seok ROH

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직무발명신고 (Invention Disclosure)

<<특허법 제39조 제40조 규정에 의거 직무와 관련된 본발명에 대해 등록받을 수 있는 권리를 회사에 양도합니다>>

■ 본 직무발명은 통신연구소 지적자산팀(수원/구미)으로 접수됩니다.

■ 발명명칭 디지털 가입자 회선 모뎀의 비등기 전송상의 피피피 프로토콜 이용 모드에서 등적 호스트 설정 프로!

■ 과제명 xDSL 비과제 ■ 과제코드 QB103 ■ 제품명 SA

■ 핵심기술(코드)명칭)

■ 기술적 내용의 평가

구분	평가내용
발명구분	◉ 자체발명 산학협동 용역개발 공동개발
	[계약서 첨부]
계약서관리	파일명 / 파일설명
	[소유권. 보상문제 기재]
공표사실	공표예정일 - 공표국가 및 단체 - 공표방법

■ 발명자인적사항

No.	사외	이 름	소속부서(기관)명 / 주민번호	대표	지분(%)	영문성명 / 주 소 (집)
1		노응석	Home G/W개발(I/Infra) / 690406-1925112	◉	100	ROH EUNG SEOK / 경기 수원시 영통구 매탄1동 194-4번지 재왕아파트 406호

Eung-Seok ROH

■ 직무발명신고파일

파일명	파일설명
DHCP_Spoofing 특허.gul	xDSL PPPoA 모드에서의 DHCP Spoofing 직무발명 신고서
DHCP_Spoofing 특허(직발수정).gul	직발서 보완. 수정

■ 발명등급판정

판정주체		판정일자	등급	의견
발명자	노응석	2001/07/26	S급(전략)	기존 기술보다 월등한 기술로서 실제 구현으로 입증
부서장	최형석	2001/07/26	S급(전략)	ADSL Modem에 적용시 타사 대비 경쟁 우위를 가
특허부서		2001/08/13	A급	전산일괄입력
평가위원회		2001/08/27	A급	전산일괄입력

■ 직무발명 진행일자 관리

발명자상신일	2001/07/26	부서장승인일	2001/07/26	특허부서접수일

Reporting date by Inventor

■ 직무발명 접수번호 : GD-200107-006-1

Exhibit "A"

SAMSUNG 삼성전자

대의비

직무발명(고안)명세서 (Invention Disclosure)		【사전체크 사항】
● 발명의 명칭 (Title of Invention) ※ 발명(고안)의 내용을 표현할 수 있는 명칭을 간단 명료하게 기재		○선출원주의이므로 신속출원이 필요함 ○완성된 발명이어야 함 - 실시예, Data등의 뒷받침이 필요 - 미완성 또는 희망사항 불가 ○출원전에 공표 금지 - 학회,논문,판매,전시 금지
국 문	디지털 가입자 회선 모뎀의 비등기 전송상의 피피피 프로토콜 이용 모드에서 동적 호스트 설정 프로토콜 스쿠핑	
영 문	DHCP Spoofing on PPP over ATM mode in xDSL Modem	

●관련 선행 기술 및 선출원	- 본 발명과 관련이 있는 기술이 이미 출원되어 있거나 현재 진행중인 것을 모두 기재함. - 국내우선권 주장이 목적이며, 최초 출원일로 부터 1년이내에는 개량출원이 가능함.					
[기술출처] (해당 부분만 선택 기재)	유사 특허 또는 출원	출원/등록번호			출원/등록일자	
		발명의 명칭				
		출 원 인				
	배경 문헌 또는 제품	문헌명/제품모델명			발표자/제조사	
		발표/제조 년월일			페이지/기타	
	발명(고안)과 관련된 발명자의 선출원	既 출원 건	발명의 명칭			
			출원번호/일자	(19 . . .)		
		진행중인 건	발명의 명칭			
			접수번호/일자	(19 . . .)		

1. 발명의 배경

가. 본 발명의 기술분야

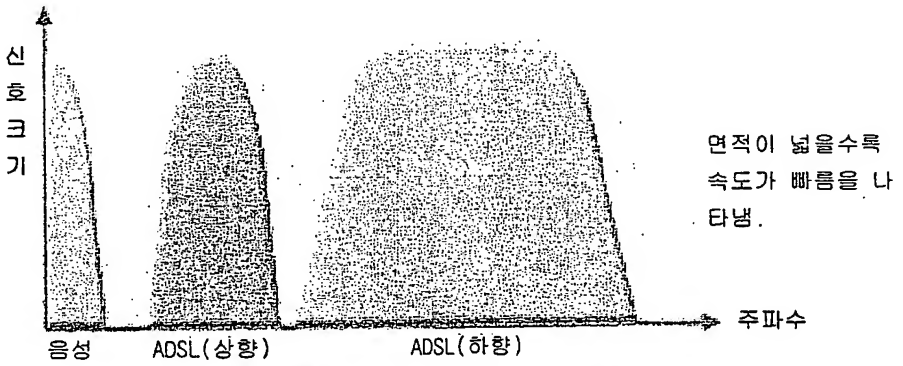
xDSL는 ADSL(Asymmetric Digital Subscriber Line : 비대칭 디지털 가입자 회선), SDSL(Single-line Digital Subscriber Line : 단선 디지털 가입자 회선), VDSL(Very high Digital Subscriber Line : 초고속 디지털 가입자 회선), HDSL(High-bit-rate Digital Subscriber Line : 고속 디지털 가입자 회선), UDSL(Universal Digital Subscriber Line : 종합 디지털 가입자 회선)등 DSL(Digital Subscriber Line : 디지털 가입자 회선) 서비스를 총칭하는 말이다.

디지털 가입자 회선(DSL)은 집에 있는 디지털 회로망과 ISP(Internet Service Provider : 인터넷 서비스 공급자)을 아날로그 전화선을 이용하여 직접 연결하는 것이다. DSL은 또한 음성 전화 신호(음성, 팩스, 등등)를 이용하는 분리된 채널을 제공하기 때문에 현행 전화선이나 전화기를 그대로 사용하면서도 고속 데이터 통신이 가능할 뿐만 아니라 데이터 통신과 일반 전화를 동시에 고속으로 주고받을 수 있는 서비스이다. DSL은 0kHz-4kHz 범위의 주파수를 아날로그 음성 신호를 위해 사용하며 4kHz-2.2MHz를 데이터 통신을 위해 사용한다.

기존 모뎀은 전화와 데이터통신을 동시에 사용할 수 없다. ISDN은 동시 사용이 가능하지만 데이터통신 속도가 절반으로 떨어진다. 하지만 xDSL은 한 개의 전화선을 이용하면서도 고속데이터통신이 가능할 뿐 아니라 데이터통신과 일반 전화를 동시에 사용하며 전화는 낮은 주파수를, 데이터통신은 높은 주파수를 사용하는 원리를 이용하기 때문에 혼선이 일어나지 않고 통신속도도

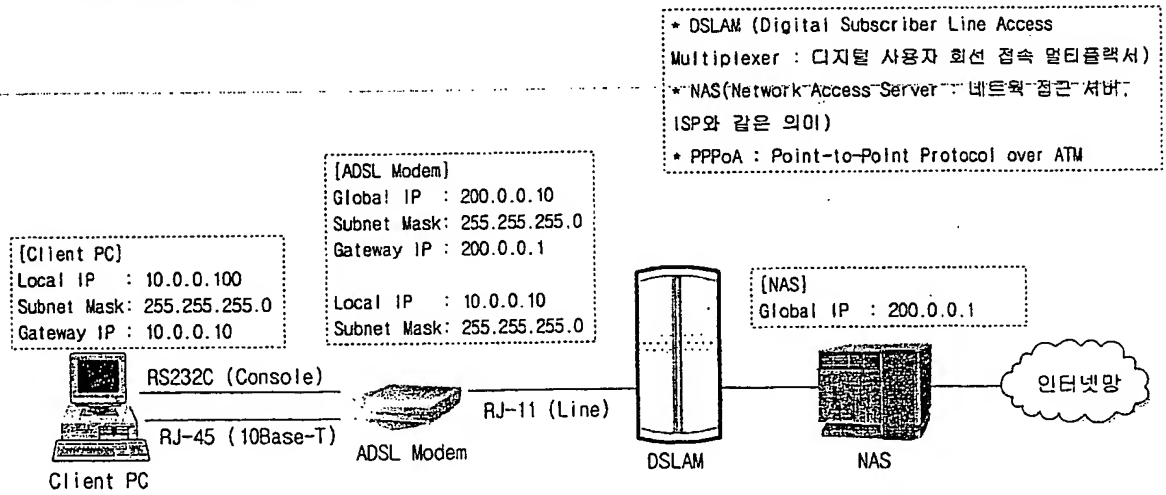
떨어지지 않는다.

xDSL중의 하나인 ADSL은 가입자와 전화국간의 데이터교환 속도가 서로 다르기 때문에 비대칭형 디지털 가입자망이라고도 부른다. 이는 그림1과 같이 "상향"보다 "하향"이 넓은 대역을 사용하기 때문이다. 기존의 하향과 상향의 통신속도가 같고 고속데이터통신을 할수 있는 CATV에 비해 통신속도가 3배정도 떨어지기는 하지만 이용자가 증가해도 통신속도가 떨어지지 않는 장점이 있다. 한 가정에서 최대 초당 12Mb의 속도를 독점 사용할 수 있다.



[그림1.동일 전화선에 음성신호와 ADSL신호]

나. 종래기술의 설명



[그림2. 기존 PPPoA 모드를 이용한 ADSL Modem 망 구성]

① NAS와 Client PC 사이에는 2개의 서로 다른 망이 구성된다.

* 상기 그림2에서 NAS와 ADSL Modem 간은 200.0.0.0 공용망이 그리고 Client PC와 ADSL Modem 간에서 10.0.0.0 사설망이 존재한다.

② ADSL Modem에서 Local IP Address와 Global IP Address 사이의 변환을 위하여 NAT(Network Address Translation)을 이용한다.

③ ADSL Modem 상의 PPP layer에서 NAS와 PPP Connection하여 Global IP Address와 Gateway IP Address정보를 가져와 ADSL Modem의 WAN port 정보로 Setting한다.

④ 사용자가 Client PC에 IP Configuration 정보인 Local IP Address, Subnet Mask, Gateway IP Address로 ADSL Modem의 Local IP Address 그리고 DNS Server Address를 입력해 주어야 한다.

⑤ Client PC와 NAS간의 Communication 시에 ADSL Modem에서 NAT을 통하여 IP Address가 Routing(IP Address Translation) 된다.

다. 종래기술 문제점 및 본 발명의 목적

- 종래기술의 문제점

① ADSL Modem에서 NAS와 Client PC 사이에는 2개의 서로 다른 망을 Routing해 주기 위해 NAT(Network Address Translation)을 사용한다. 그렇기 때문에 RFC1631에 명시되어 있듯이 NAT의 한계성으로 인한 문제가 있다.

ⓐ NAT table이 증가함에 따라 Performance가 감소한다.

ⓑ Mis-addressing의 가능성이 증가한다.

ⓒ NAT를 사용할 경우에 IP 패킷의 Payload에 IP Address가 들어가는 특정 애플리케이션 적용에 문제점이 있다.

ⓓ Host의 Identity을 숨김으로 인하여 Privacy을 가질 수 있는 반면에 일반적으로는 Negative Effect을 초래한다.

ⓔ SNMP, DNS에서의 문제점이 존재한다.

② NAS는 사용자의 PC가 Power Off 되어 있을 지라도 사용자의 외장형 ADSL Modem이 Power On 되어 있는 동안에는 ADSL Modem에 할당하였던 Global IP Address을 회수하여 다른 사용자의 ADSL Modem에 할당할 수 없다. 이로 인하여 NAS에서의 Global IP Address의 소모가 많게 된다.

③ 사용자가 적어도 한번은 직접 사용자 PC에 IP Configuration 정보를 Setting시켜야 하는 불편함이 있다.
(IP Address, Gateway Address, Subnet Mask, DNS Server Address)

④ PPPoA 모드에서의 상기 3개 항목에 대한 단점이 없는 PPPoE(PPP over Ethernet)모드를 ISP(Internet Service Provider : 인터넷 서비스 공급자)가 제공할 경우에는 다음과 같은 문제점이 발생하고 있다.

ⓐ 사용자 PC에 PPPoE Driver가 필요하게 되므로 PPPoE Driver가 내포된 인터넷 접속 소프트웨어를 사용자가 별도로 설치해야 한다.

ⓑ ISP나 사용자는 인터넷 접속 소프트웨어에 대한 비용을 추가로 부담해야 한다.

ⓒ 사용자의 부주의로 인터넷 접속 소프트웨어 구성파일 및 관련된 공용파일이 지워질 경우에 다시 재설치해야 하는 불편함이 있다.

ⓓ 비록 재설치를 하여도 인터넷 접속 소프트웨어에서 사용하는 공용파일이 타 애플리케이션과 충돌할 수 있는 문제가 항시 내포되어 있다. 이로인한 A/S가 ISP에게 부담이 되고 있다.

ⓔ 인터넷 접속 소프트웨어를 위해서 사용자 PC가 별도의 자원을 배분해야 하고 인터넷 접속 시에 항상 인터넷 접속 소프트웨어를 먼저 로딩해야 한다.

ⓕ 인터넷 접속 소프트웨어의 사용자 ID와 Password에 대한 관리가 항상 사용자에게 노출되어 있고 전적으로 사용자에게 의존되어 있다.

- 본 발명의 목적

① NAS와 Client PC 사이를 단일망으로 만들어 서로 다른 망을 Routing해 주기 위해 사용했던 NAT를 제거한다. 그리고 NAS와 Client PC간에 단일망으로 만들어 주기 위해서 ADSL Modem에서 NAS와 PPP connection을 연결하여 얻는 Global IP Address, Gateway IP Address 등을 Client PC에 넘겨준다. 이를 위하여 ADSL Modem에 DHCP Server을 구현한다.

② ADSL Modem이 Client PC와 NAS 간의 Data 전달할 시에 Bridge로 동작하도록 개선한다. 이로 인하여 성능을 개선시킨다.

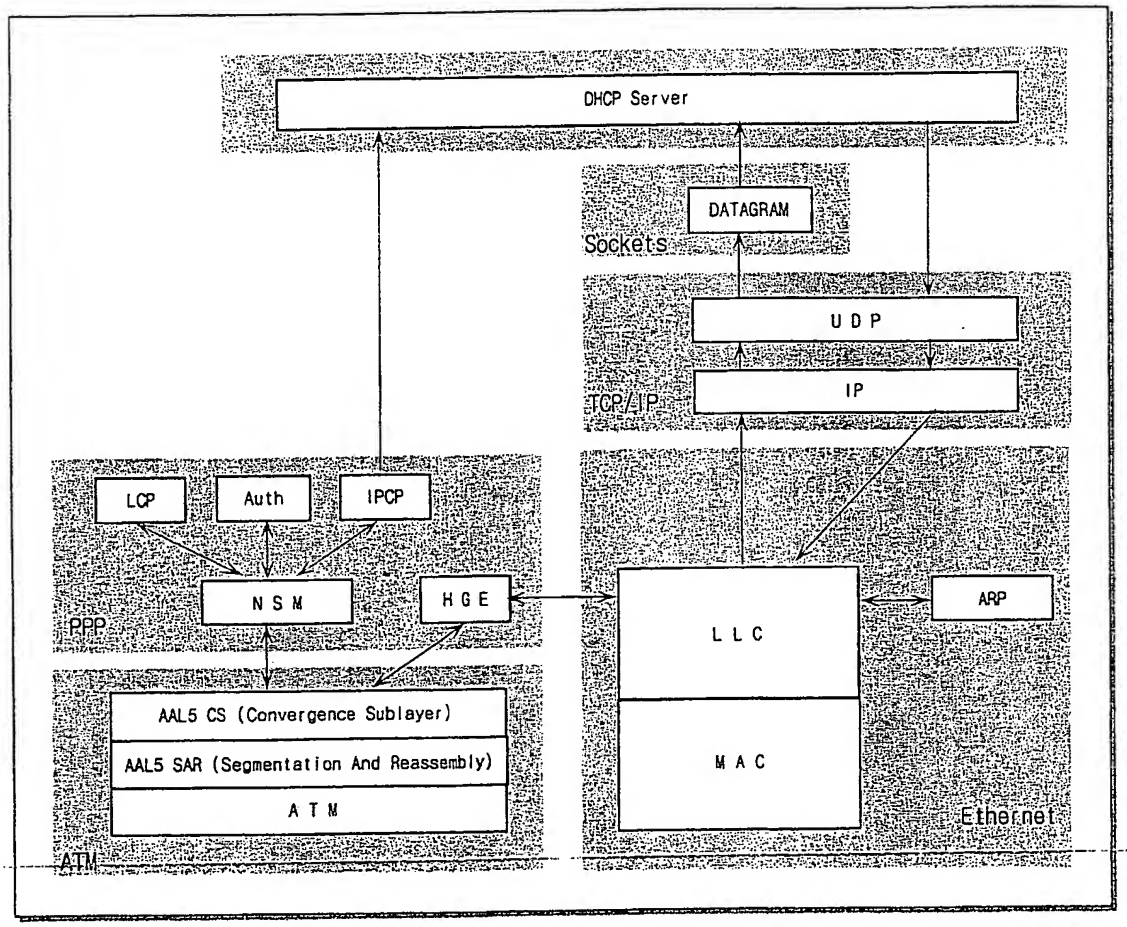
③ ADSL Modem의 DHCP는 Client PC의 Operating System에 내재되어 있는 DHCP Client에 대해서 Server로 동작하여 사용자가 직접 PC에 IP Configuration할 필요가 없도록 개선하여 사용자의 편의를 도모한다.

④ NAS에서 제공한 Global IP Address을 Client PC에 그대로 사용하여 Local IP Address을 추가적으로 사용할 필요가 없도록 개선시킨다.

⑤ ADSL Modem이나 Client PC중에 하나라도 Power Off되면 NAS가 할당하였던 Global IP Address을 회수할 수 있도록 하여 NAS에서의 Global IP Address에 대한 소모를 최소화시킨다.

2. 발명(고안)의 구체적 설명

가. 발명의 구성

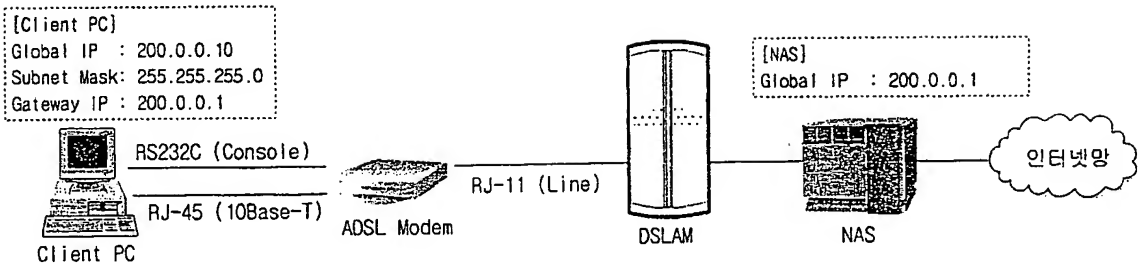


[그림 3. ADSL Modem에서의 프로토콜 구성 및 데이터 흐름]

* DHCP : Dynamic Host Configuration Protocol
* HGE : Header Generation/Extraction
* Auth : Authentication
* ATM : Asynchronous Transfer Mode
* IP : Internet Protocol
* LLC : Logical Link Control
* ARP : Address Resolution Protocol
* NSM : Negotiation State Machine
* LCP : Link Control Protocol
* IPCP : Internet Protocol Control Protocol
* UDP : User Datagram Protocol
* PPP : Point-to-Point Protocol
* MAC : Media Access Control
* AAL : ATM Adaption Layer

본 발명의 구성요소는 그림3에서 도시된 바와 같이 NAT는 제거되었고 그 대신 DHCP Server가 추가되며 기존 PPP layer에서 DHCP Server로 사용자 PC에서 필요한 IP Configuration 정보를 전달할 수 있도록 구성된다. 그리고 ADSL Modem에서 IP Packet을 전달함에 있어 NAS와 ADSL Modem사이가 PPP 통신이므로 PPP Header을 추가하거나 제거하기 위해서 그에 상응하는 HGE(Header Generation/Extraction) 부분이 추가된다.

나. 발명의 동작설명



[그림4. PPPoA 모드에서 DHCP Spoofing을 이용한 ADSL Modem 망 구성]

ADSL Modem에서 PPP IPCP로 NAS에서 Global IP Address을 얻어 이를 Client PC에 주기 때문에 NAS와 Client PC 사이는 단일망으로 구성된다(그림4에서는 NAS와 Client PC간에서 200.0.0.0 공용망이 존재). Client PC가 Booting 될 시에 Client PC의 DHCP Client가 동작되어 ADSL Modem의 DHCP Server을 찾기 위해서 DHCP-DISCOVER 패킷을 네트워크에 Broadcast한다. 이 때 DHCP-DISCOVER 패킷을 받은 ADSL Modem의 DHCP Server는 NAS와 ADSL Modem사이에 PPP session 열리도록 동작하고 Client PC가 사용할 Global IP Address, Gateway IP Address 그리고 DNS Server Address와 같은 IP Configuration 정보를 PPP IPCP을 통하여 얻는다. 그 후에 Modem은 Subnet Mask을 만들어 NAS에서 받은 IP Configuration 정보와 함께 DHCP-OFFER와 DHCP-ACK 패킷에 실어 PC의 DHCP Client에 보내게 된다. 그리고 DHCP-ACK 패킷을 받은 Client PC의 DHCP Client의해서 IP Configuration 정보가 Client PC에 설정되어진다. 이로서 Client PC와 NAS간은 단일망이 구성되었으므로 상호간에 Communication시에 ADSL Modem에서 별도의 Routing 과정이 필요없이 Bridging 기능을 수행한다. 한편 Client PC로부터 일정시간(Lease Time×3)동안 Lease Time을 갱신하기 위해서 DHCP-REQUEST가 없으면 DHCP Server는 연결되어 있는 PPP Session을 종료시켜 NAS가 배분했던 Global IP Address을 회수할 수 있도록 한다. 이에 대한 자세한 동작 방식은 이후에 기술되는 바와 같다.

①. ADSL Modem이 부팅되면서 DHCP Server가 서비스할 준비가 된다.

②. Client PC가 부팅되면 아래와 같은 절차가 이루어진다.

ⓐ Client PC의 Operating System에 내재되어 있는 DHCP Client가 동작되어 ADSL Modem의 DHCP Server을 찾기 위해서 DHCP-DISCOVER 패킷을 네트워크에 Broadcast한다.

ⓑ DHCP-DISCOVER 패킷을 받은 ADSL Modem의 DHCP Server는 NAS와 ADSL Modem사이에 PPP Session 열기 위한 절차를 수행시킨다.

ⓒ PPP Session이 Connection된 후에 PPP IPCP는 Client PC가 사용할 Global IP Address, Gateway IP Address 그리고 DNS Server Address와 같은 IP Configuration 정보를 얻는다. 이때의 PPP IPCP 처리 Flow와 알고리즘은 기존과 동일하다. 단지 DNS Server 값도 얻을 수 있도록

ADSL Modem에서 NAS로 Configure-Request시에 IPCP Option 81(Primary-DNS-Address)과 IPCP Option 83(Secondary-DNS-Address)을 추가하고 이에 대한 NAS에서의 Response을 처리할 수 있도록 처리한다. NAS에서 얻게 되는 정보는 아래와 같다.

▸ Local IP Address : NAS가 Client PC가 사용하도록 할당한 Global IP Address.

▸ Remote IP Address : Client PC가 Gateway IP Address를 사용할 NAS에 대한 IP Address.

▸ DNS Server Address : ADSL Modem은 NAS에 Primary-DNS-Address와 Secondary-DNS-Address 들 다 요구하여 받는다. 이 때에 NAS에 Primary-DNS-Address와 Secondary-DNS-Address 값이 설정되어 있지 않아 ADSL Modem에서 요구한 Data를 얻지 못할 시에는 Flash Memory에 저장되어 있는 DNS Server Address 정보를 이용한다.

ⓓ 상기 ①항목에서 PPP IPCP는 얻어 온 IP Configuration 정보를 DHCP Server에 전달한다.

ⓔ ADSL Modem의 DHCP Server는 DHCP-DISCOVER에 대한 Response인 DHCP-OFFER 패킷에 ADSL Modem의 Default IP Address을 포함한 IP Configuration과 관련된 정보를 Client PC에 보낸다. 이 때 보내지는 패킷에 포함되는 중요한 정보는 다음과 같다.

▸ NAS에서 얻은 Global IP Address, Gateway IP Address 그리고 DNS Server Address등.

▸ Lease Time과 Lease Renewal Time 값(Test 결과 상기 ⓒ항목의 값의 변경을 신속히 PC에 적용시키기 위해서 5초가 적당하였음).

▸ Global IP Address와 Gateway IP Address가 만들 수 있는 최소한의 Subnet Mask.

```
for(int n_count=31; n_count > 0; n_count--) {
    if((Global_IP_Address >> n_count) != (Gateway_IP_Address >> n_count)) {
        n_count ++;
        break;
    }
}
subMask = (0xFFFFFFFF >> n_count);
subMask = (subMask << n_count);
```

— Subnet Mask 생성 루틴 —

ⓕ Client PC는 DHCP-OFFER 패킷을 받아 DHCP-REQUEST 패킷을 Broadcast한다.

ⓖ ADSL Modem의 DHCP Server는 DHCP-REQUEST 패킷을 받아 상기 ⓔ항목의 IP Configuration 정보를 다시 DHCP-ACK 패킷에 실어 Client PC에 해당하는 Unicast Ethernet Address로 보낸다.

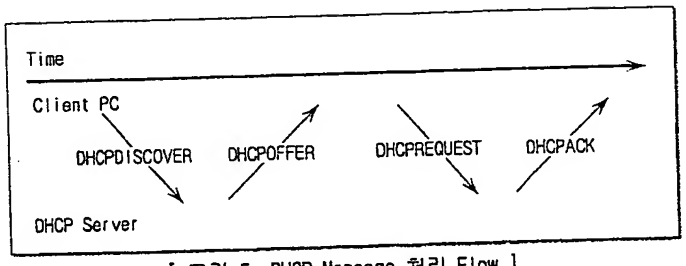
ⓗ DHCP-ACK 패킷을 받은 Client PC의 DHCP Client의해서 IP Configuration 정보가 Client PC에 설정되어진다. 이로서 Client PC와 NAS간은 단일망이 구성된다.

① 상기 메시지 처리 과정에서의 병행되는 ARP 처리는 기존의 처리과정과 동일하고 그리고 DHCP Message 처리는 RFC2131에 따른다.

▸ ARP 처리

```
if(packet is ARP request about gateway)
        ARP reply sending
        (make packet :PC GATEWAY IP and board hardware address mapping)
```

▸ DHCP Message 처리



[그림 5. DHCP Message 처리 Flow]

① Client PC의 DHCP Client가 Lease Renewal Time이 지나면 새로운 Lease Time을 얻기 위하여 ADSL Modem의 Default IP Address로 DHCP REQUEST 패킷을 보낸다.

ⓚ DHCP REQUEST 패킷을 받은 ADSL Modem의 DHCP Server는 ⑨와 같은 DHCP ACK 패킷을 Client PC에 해당하는 Unicast Ethernet Address로 보낸다.

③ 가슴한 ②항목에 대한 ADSL Modem상에서 DHCP 패킷 처리 Flow는 아래와 같이 이루어진다.

ⓐ ADSL Modem의 Data Link layer인 LLC에서 Client PC로부터 받는 모든 Frame을 처리하는 루틴에서

```
if(DHCP Packet인지를 Check)
    DHCP Server Task가 받아 처리할 수 있도록 Socket으로 하여 상위 Layer에 올린다.
else
    IP Packet Processing한다.
```

ⓑ DHCP Server Task의 Socket을 받아 처리하는 루틴에서

```
if(Received Packet이 IP Header와 UDP Header을 제외한 DHCP Data Packet이다)
    Message Type에 따라 해당하는 처리 Routine을 호출한다.
    < 예 >
    ▸ DHCP-DISCOVER 패킷일 경우는 DHCP-OFFER 패킷을 만들어 보내는 discover함수를 호출.
```

▸ DHCP-REQUEST 패킷일 경우는 DHCP-ACK이나 DHCP-NAK 패킷을 만들어 보낼 수 있도록 request함수를 호출.

ⓒ DHCP Packet을 Sending하는 함수에서

▸ UDP와 IP Header을 붙인다. 이 때에 IP Address는 ADSL Modem의 Default IP Address가 된다.

▸ Client PC에 보내지도록 Data Link Layer에 만들어진 Packet을 넘긴다.

④. Client PC에서 보낸 IP Packet에 대한 ADSL Modem상에서 Data처리 Flow는 아래와 같이 이루어진다.

ⓐ ADSL Modem의 Data Link layer에서 Client PC로부터 받는 모든 Frame을 처리하는 루틴에서

```
if(DHCP Packet인지를 Check)
    DHCP Server Task가 받아 처리할 수 있도록 Socket으로 하여 상위 Layer에 올린다.
else    /* DHCP이외의 Packet */
    EtherRxMsg 함수를 호출.
```

ⓑ EtherRxMsg 함수에서 해당 Frame을 Queue로 Send한다.

ⓒ 상기 ⓑ에서 Queue에 넣은 Frame을 계속해서 받아 처리하는 EtherRxTask함수에서

```
if(Frame Type이 ARP)
    ARP 처리 루틴을 호출(기존과 동일).
else if(Frame Type이 IP Packet)
    user_ip_sys 함수를 호출하여 처리한다.
```

ⓓ user_ip_sys 함수에서의 처리는 ADSL Modem의 PPP layer에서의 HGE module에서의 기능 중에 PPP Header Generation 역할을 한다. 그 후에 ATM SAR을 통하여 ATM Cell을 NAS로 보낼 수 있도록 PPP Frame을 ATM Layer로 전달한다.

⑤. NAS에서 보낸 PPP IP Packet에 대한 ADSL Modem상에서 Data처리 Flow는 아래와 같이 이루어진다.

ⓐ ADSL Modem의 ATM layer에서 NAS로부터 받는 모든 Data Frame을 PPP layer에서 처리하도록 Queue로 Send한다.

ⓑ 상기 ⓐ에서 Queue에 넣은 Data Frame을 PPP layer에서 계속해서 받아 처리하는 루틴에서

```
if(PPP header의 Protocol이 PPP IP이다) {
    RIP packet은 Discard 시킨다.
    PPP Header을 제거한다(ADSL Modem의 PPP layer에서의 HGE module에서의 PPP Header Extraction 역할).
```

SendMsg2EhterTx 함수를 호출한다.

}

else

PPP Negotiation을 처리한다(기존과 동일).

ⓒ SendMsg2EhterTx 함수에서 Frame을 Client PC로 보낼 수 있도록 Data Link Layer로 전달한다.

⑥. Client PC가 Shut-down 되면 아래와 같은 절차가 이루어진다.

ⓐ ADSL Modem의 DHCP Serversms Client PC가 Shut-down 되었기 때문에 일정시간(Lease_Time×3)이 지나도 DHCP-REQUEST 패킷을 Client PC로부터 받을 수 없게 된다.

ⓑ DHCP Server는 연결되어 있는 PPP Session을 종료시켜 NAS가 배분했던 Global IP Address을 회수할 수 있도록 한다

다. 발명의 효과

①. Client PC에서 변경 및 인터넷 접속 소프트웨어를 설치 하지 않아도 PC 부팅 후 바로 통신을 할 수 있다. 이로 인하여 사용자의 오작동 및 실수로 인하여 발생할 수 있는 문제점들이 제거되었다.

②. ADSL Modem에서는 자체 한계성을 갖고 있는 NAT(Network Address Translation)을 이용할 필요가 없다.

③. ADSL Modem에서 성능의 저하를 초래하는 NAT을 사용하지 않음으로 인하여 성능의 개선 효과가 있다. 본 발명을 적용한 ADSL Modem의 Down 속도가 표1와 같이 기존 NAT 사용한 ADSL Modem보다 평균 33%의 성능이 향상되었다. 그런데 표1의 실험결과는 단순히 하나의 파일에 대한 것이고 실질적으로 Long-Run Test을 하면 NAT을 이용한 ADSL Modem은 NAT의 한계성으로 인하여 속도에 대한 성능이 저하되지만 본 발명에 의한 ADSL Modem은 성능의 변화가 없다.

NAT 이용한 기존 방식		DHCP Spoofing 방식	
- Actual Link Rate - Down: 8.8M Up: 704K		- Actual Link Rate - Down: 8.544M Up: 726K	
Test 1	5.42M (Down)	Test 1	7.20M (Down)
Test 2	5.40M (Down)	Test 2	7.12M (Down)
Test 3	5.41M (Down)	Test 3	7.24M (Down)
Test 4	643.24K (Up)	Test 4	699.09K (Up)
Test 5	666.73K (Up)	Test 5	701.02K (Up)

[표1. File Size가 100M을 Download 그리고 10M을 Upload하여 Test한 평균속도]

④. NAS와 Client PC 사이에 단일망으로 구성되고 Client PC는 NAS에서 제공하는 Global IP

Address 및 DNS Server Address 이용할 수 있고 별도의 Local IP Address을 사용할 필요가 없다. 이로 인하여 사용자가 별도로 IP Address를 관리할 필요가 없다.

⑤. ADSL Modem이나 Client PC중에 하나라도 Power Off되면 NAS가 할당하였던 Global IP Address가 회수되므로 NAS에서의 Global IP Address에 대한 소모가 최소화된다.

⑥. ADSL Modem에서 사용되는 DHCP Server는 IP Configuration 정보를 PPP IPCP을 통하여 NAS에서 얻어 오게 되는 DHCP Spoofing기능을 수행하므로 IP Pool이 필요가 없다 이로 인하여 사용자가 별도로 DHCP Server의 IP Pool을 관리해야 하는 부담이 없다.

3. 권리청구의 범위

1. 상위개념(독립항)

xDSL Modem의 PPPoA 모드에서 제 1항의 단계, 제 2항의 단계 그리고 제 3항의 단계로 이루어지는 DHCP Spoofing 기능을 하는 방법.

㉮. 제 1항
사용자 PC가 부팅이 되면 ADSL Modem에서 NAS로 PPP Connection 맺고 PPP IPCP을 통하여 얻을 수 있는 IP Configuration 정보를 ADSL Modem의 DHCP Server에 전달하고 DHCP Server가 그 정보를 Client PC에 곧바로 전달하여 NAS와 사용자 PC간에 단일망으로 구성시키는 단계.

㉯. 제 2항
NAS와 Client PC 사이에서의 IP 패킷 전달을 ADSL Modem에서 Bridging 시키는 단계.

㉰. 제 3항
Client PC가 Power Off될 시에 NAS가 기 할당하였던 Global IP Address을 회수할 수 있도록 ADSL Modem에서 처리하는 단계.

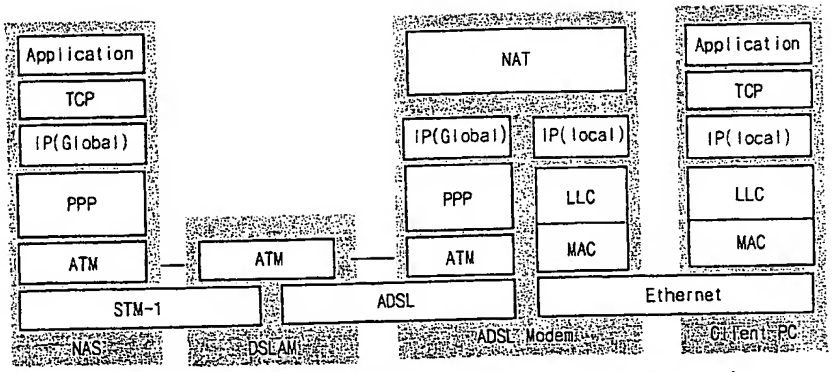
2. 하위개념(종속항)

㉮. 제 1항
상위개념의 제2항에 대한 ADSL Modem의 DHCP Server가 NAS로부터 PPP IPCP을 통하여 IP Configuration 정보를 받아 Client PC에 제공하는 DHCP Spoofing기능을 하는 DHCP Server을 구현하는 방법과 Global IP Address와 Gateway Address 사이에 구성될 수 있는 최소의 Subnet Mask을 생성시키는 방법.

㉯. 제 2항
상위개념의 제2항에 대한 ADSL Modem이 IP 패킷을 Bridging 시키는 단계에 있어, IP Packet의 전달이 NAS에서 Client PC일 때에 PPP Header을 추가하고 IP Packet의 전달이 Client PC에서 NAS일 때는 PPP Header을 제거하면서 IP 패킷을 전달하는 방법.

4. 도 면

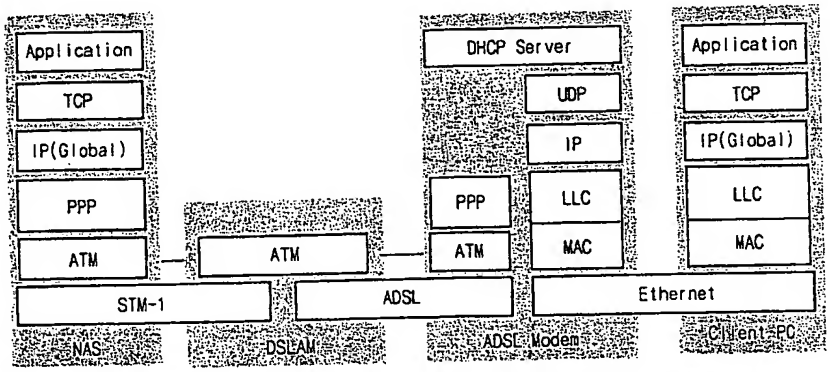
가. 종래기술의 도면



[그림6. PPPoA 모드에서 NAT을 이용한 기존 망의 프로토콜 구성]

NAS 즉, ISP가 제공하는 Global IP Address는 ADSL Modem의 WAN Port용 IP Address로 할당되고 ADSL Modem의 LAN Port용 IP Address는 사용자 PC와 동일한 Local 망의 Gateway IP Address값이 된다. NAT는 사용자 PC에서 들어오는 IP Packet에서 사용자 PC의 Local IP Address을 NAS에서 제공했던 Global IP Address로 변경한 후에 NAS에 전달한다. 그리고 NAS에서 들어오는 IP Packet에서 Global IP Address을 사용자의 PC의 Local IP Address로 변환하여 사용자 PC에 전달하게 된다. 아울려 ADSL Modem에서 IP Packet을 전달할 때에 PPP Layer에서는 PPP Header 정보를 더하거나 빼는 역할을 수행한다.

나.본 발명의 도면



[그림7. PPPoA 모드에서 DHCP Spoofing을 적용한 망의 프로토콜 구성]

ADSL Modem에서 PPP을 통하여 NAS로부터 얻은 IP Configuration 정보를 DHCP Server에 전달하고 DHCP Server는 그 정보를 다시 Client PC의 DHCP Client에게 전달한다. 그리하여 NAS와 Client PC 사이에 단일망으로 구성되므로 통신 시에 ADSL Modem에서 별도의 Routing(IP Address Translation)과정이 필요없이 Bridging 기능만을 수행한다.

CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Invention Disclosure with respect to the U.S Provisional patent application No. **60/316,282** filed on **September 4, 2001.**

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Date : June 22, 2005

RESIDENCE : MIHWA BLDG., 110-2, MYONGRYUN-DONG 4-GA, CHONGRO-GU, SEOUL 110-524, KOREA

CITIZENSHIP : REPUBLIC OF KOREA

Exhibit "B"

INVENTION DISCLOSURE

Title of the Invention

DHCP Spoofing on PPP over ATM mode in xDSL Modem

1. Background of the invention

A. Description of the invention

The term xDSL is a generic term of Digital Subscriber Line (DSL) services such as Asymmetric Digital Subscriber Line (ADSL), Single-line Digital Subscriber Line (SDSL), Very high Digital Subscriber Line (VDSL), High-bit-rate Digital Subscriber Line (HDSL), and Universal Digital Subscriber Line (UDSL).

The Digital Subscriber Line (DSL) allows a digital network in a house to be directly connected to an Internet Service Provider (ISP) using analog telephone line. In addition, since the DSL provides a separated channel using a voice call signal (voice, fax, etc.), the DSL is a service of enabling high-speed data communication using a current telephone line or telephone and simultaneously transmitting/receiving data and general telephone calls at a high speed. The DSL uses frequencies in a 0 to 4 KHz band for analog voice signals and frequencies in a 4 KHz to 2.2 MHz band for data communication.

The telephone call and data communication cannot be simultaneously used with a conventional modem. In Integrated Services Digital Network (ISDN), the call and data communication can be simultaneously used, but a data communication rate is reduced by a half. However, the xDSL enables high-speed data communication using one telephone line and the simultaneous use of data communication and telephone call. In addition, since the xDSL uses a principle in which the telephone call uses a low frequency and the data communication uses a high frequency, neither crosstalk occurs nor a communication rate is reduced.

The ADSL, one of the xDSL, is called an asymmetric digital subscriber network since data exchange rates between a subscriber and a telephone office are different from each other. This is because "downstream" uses a wider band than what "upstream" uses as shown in FIG. 1. Though a communication rate is around one third of that of conventional CATV in which a downstream communication rate is equal to an upstream communication rate and in which high-speed data communication is possible, there

exists an advantage that the communication rate does not drop even if the number of subscribers increases. One house can exclusively use a data rate of maximum 12 Mbps.

FIG. 1: a voice signal and ADSL signals on the same telephone line
AMPLITUDE OF SIGNAL
VOICE
UPSTREAM
DOWNSTREAM
FREQUENCY
A WIDER AREA INDICATES A HIGHER DATA RATE.

B. Description of the prior art

FIG. 2: configuration of a conventional ADSL modem network using a PPPoA mode
Digital Subscriber Line Access Multiplexer
Network Access Server, i.e., ISP
Internet Network

(1) Two different networks are configured between an NAS and a client PC.

* In FIG. 2, a 200.0.0.0 public network exists between the NAS and an ADSL modem, and a 10.0.0.0 private network exists between the client PC and the ADSL modem.

(2) In the ADSL modem, Network Address Translation (NAT) is used for conversion between a local IP address and a global IP address.

(3) Information on the global IP address and a gateway IP address is obtained by PPP connecting with the NAS in a PPP layer of the ADSL modem and set as wide area network (WAN) port information of the ADSL modem.

(4) A user should input the local IP address of the ADSL modem and a domain name service (DNS) server address to the client PC as IP configuration information such as the local IP address, a subnet mask, and the gateway IP address.

(5) An IP address is routed (IP-address-translated) in the ADSL modem using the NAT when communication is performed between the client PC and the NAS.

C. Problems in the prior arts and purposes of the invention

- Problems in the prior arts

(1) In an ADSL modem, the NAT is used to route two different networks between a NAS and a client PC. Thus, problems due to limitation of the NAT exist as stated in RFC1631.

(a) Performance decreases when a NAT table increases.

(b) Possibility of mis-addressing increases.

(c) In a case of using the NAT, there exists a problem in that a specific application in which an IP address is included in a payload of an IP packet is applied.

(d) Privacy can be secured by hiding identity of a host, whereas a negative effect is caused in general.

(e) Problems exist in Simple Network Management Protocol (SNMP) and DNS.

(2) Though the client PC is turned off, during a power-on state of an external ADSL modem of the user, the NAS cannot withdraw a global IP address, which has been allocated to the ADSL modem, or allocate the global IP address to an ADSL modem of another user. Due to this, consumption of global IP addresses in the NAS increases.

(3) The user should directly set IP configuration information (IP address, gateway address, subnet mask, and DNS server address) to the client PC at least once.

(4) In a case where an ISP provides a PPPoE (PPP over Internet) mode that does not have the disadvantages on the above three items in the PPPoA mode, there exists problems as follows.

(a) Since a PPPoE driver is required for the client PC, the user should separately install Internet access software in which the PPPoE driver is included.

(b) The ISP or the user should additionally pay for the charge for the Internet access software.

(c) In a case where an Internet access software configuration file and relevant global files are deleted due to carelessness of the user, the user should re-install the Internet access software.

(d) There is always connoted a problem that the global files used in the Internet access software may collide with other applications even after the re-installation. After service (A/S) due to this is a burden on the ISP.

(e) The client PC should share separate resources for the Internet access software and always load the Internet access software first when an Internet access is tried.

(f) Management of a user ID and password in the Internet access software is always

exposed to the user and entirely depends on the user.

- Purposes of the invention

(1) A NAT used to route different networks is removed by configuring a single network between a NAS and a client PC. To configure a single network between the NAS and the client PC, an ADSL modem transmits a global IP address and a gateway IP address obtained by PPP connecting with the NAS to the client PC. To do this, a Dynamic Host Control Protocol (DHCP) server is implemented in the ADSL modem.

(2) The ADSL modem is modified to operate as a bridge when the ADSL modem transfers data between the client PC and the NAS. Due to this, performance is improved.

(3) DHCP of the ADSL modem is modified by operating as a server for a DHCP client included in the Operating System (OS) of the client PC so that a user does not have to directly perform IP configuration for the PC, thereby improving convenience of the user.

(4) Modification is performed so that a local IP address is not additionally used by using the global IP address provided by the NAS for the client PC as it is.

(5) Consumption of global IP addresses in the NAS is minimized by withdrawing the global IP address allocated by the NAS if any one of the ADSL modem and the client PC is turned off.

2. Detailed description of the invention

A. Configuration of the present invention

FIG. 3: protocol configuration and data flow in an ADSL modem

A NAT is removed from components of the present invention and a DHCP server is added instead as shown in FIG. 3, and the components are configured so that a conventional PPP layer can IP configuration information required for a client PC to the DHCP server. In addition, since PPP communication is performed between a NAS and an ADSL modem when the ADSL modem transmits an IP packet, a Header Generation/Extraction (HGE) part is added to add or remove a PPP header.

B. Operational principle of the present invention

FIG. 4: configuration of an ADSL modem network using DHCP spoofing in the

PPPoA mode

Internet network

Since an ADSL modem receives a global IP address from the NAS using a PPP Internet Protocol Control Protocol (IPCP) and transmits the global IP address to a client PC, a single network is configured between the NAS and the client PC (in FIG. 4, a 200.0.0.0 public network exists between the NAS and the client PC). When the client PC is booted, a DHCP client of the client PC operates and then broadcasts a DHCP-DISCOVER packet to the network in order to search for a DHCP server of the ADSL modem. The DHCP server of the ADSL modem, which has received the DHCP-DISCOVER packet, operates to open a PPP session between the NAS and the ADSL modem and obtains IP configuration information, such as a global IP address, a gateway IP address, and a DNS server address, to be used by the client PC using the PPP IPCP. Then, the modem generates a subnet mask and transmits the subnet mask to the DHCP client of the PC by loading it in DHCP-OFFER and DHCP-ACK packets with the IP configuration information received from the NAS. The IP configuration information is set to the client PC by the DHCP client of the client PC, which has received the DHCP-ACK packet. By doing this, since a single network is configured between the NAS and the client PC, the ADSL modem performs a bridging function without a separate routing process when communication is performed between the NAS and the client PC. If DHCP-REQUEST to update a lease time is not transmitted from the client PC for a predetermined time (lease time × 3), the DHCP server terminates the connected PPP session so that the NAS can withdraw the allocated global IP address. A detailed operating method for this is as follows.

(1) The DHCP server is ready to provide a service when the ADSL modem is booted.

(2) When the client PC is booted, following procedures are performed.

(a) The DHCP client included in the OS of the client PC operates and then broadcasts a DHCP-DISCOVER packet to the network in order to search for the DHCP server of the ADSL modem.

(b) The DHCP server of the ADSL modem, which has received the DHCP-DISCOVER packet, performs a process to open a PPP session between the NAS and the ADSL modem.

(c) After the PPP session is connected, the PPP IPCP obtains IP configuration information, such as a global IP address, a gateway IP address, and a DNS server

address, to be used by the client PC. A PPP IPCP processing flow and algorithm of this case is the same as that in the prior art. However, an IPCP option 81 (primary-DNS-address) and an IPCP option 83 (secondary-DNS-address) are added to also obtain a DNS server value when the ADSL modem transmits a configure-request to the NAS and a process is performed to process a response from the NAS. Information obtained from the NAS is as follows.

► Local IP address: a global IP address allocated by the NAS for the client PC to use.

► Remote IP address: an IP address of the NAS for which the client PC uses a gate IP address.

► DNS server address: the ADSL modem requests the primary-DNS-address and the secondary-DNS-address for the NAS and receives both from the NAS. If the ADSL modem cannot obtain the requested data since the primary-DNS-address and secondary-DNS-address values are not established in the NAS, DNS server address information stored in a flash memory is used.

(d) In the item (1), the PPP IPCP transmits the obtained IP configuration information to the DHCP server.

(e) The DHCP server of the ADSL modem transmits the IP configuration information, which includes a default IP address of the ADSL modem, in a DHCP-OFFER packet, which is a response to the DHCP-DISCOVER, to the client PC. Important information included in the transmitted packet is as follows.

► The global IP address, the gateway IP address, and the DNS server address obtained from the NAS.

► Lease time and lease renewal time values (As a result of test, 5 seconds are appropriate to quickly apply a change of the values in the item (c) to the PC).

► A least subnet mask generated by the global IP address and the gateway IP address.

```
for(int n_count=31; n_count > 0; n_count--) {
        if((Global_IP_Address>>n_count) !=(Gateway_IP_address>>n_count)) {
                n_count ++;
                break;
        }
}
subMask = (0XFFFFFFFF >> n_count);
subMask = (subMask << n_count);
```

- Subnet Mask generation routine -

(f) The client PC receives the DHCP-OFFER packet and broadcasts a DHCP-REQUEST packet.

(g) The DHCP server of the ADSL modem receives the DHCP-REQUEST packet, loads the IP configuration information of the item (e) in a DHCP-ACK packet, and transmits the DHCP-ACK packet to a unicast Ethernet address corresponding to the client PC.

(h) The IP configuration information is set to the client PC by the DHCP client of the client PC, which has received the DHCP-ACK packet. By doing this, the single network is configured between the client PC and the NAS.

(i) Address Resolution Protocol (ARP) processing accompanied to the message processing procedures is the same as that in the prior art, and DHCP message processing follows RFC2131.

- The ARP processing

if(packet is ARP request about gateway)

ARP reply sending

(make packet :PC GATEWAY IP and board hardware address mapping)

- The DHCP message processing

FIG. 5: a DHCP message processing flow

(j) After the lease renewal time, the DHCP client of the client PC transmits a DHCP-REQUEST packet to the default IP address of the ADSL modem in order to obtain a new lease time.

(k) The DHCP server of the ADSL modem, which has received the DHCP-REQUEST packet, transmits the same DHCP-ACK packet as illustrated in the item (g) to the unicast Ethernet address corresponding to the client PC.

(3) A DHCP packet processing flow in the ADSL modem for the said item (2) is performed as follows.

(a) In a routine processing all frames received from the client PC in a link layer control (LLC), which is a data link layer of the ADSL modem,

if(check a DHCP packet or not)

generates a socket so as to be received and processed by a DHCP server task and transmits the socket to an upper layer.

else

performs IP packet processing.

(b) In a routine receiving and processing the socket of the DHCP server task,

if(the received packet is a DHCP data packet obtained by excluding an IP header and a UDP header)

call a relevant processing routine according to a message type.

<an example>

► call a discover function of generating and transmitting a DHCP-OFFER packet in a case of a DHCP-DISCOVER packet.

► call a request function to generate and transmit a DHCP-ACK or DHCP-NAK packet in a case of a DHCP-REQUEST packet.

(c) In a function sending a DHCP packet,

► UDP and IP headers are attached. Herein, an IP address is the default IP address of the ADSL modem.

► The generated packet is transmitted to the data link layer so that the generated packet is transmitted to the client PC.

(4) A data processing flow in the ADSL modem for an IP packet transmitted from the client PC is performed as follows.

(a) In the routine processing all frames received from the client PC in the data link layer of the ADSL modem,

if(check a DHCP packet or not)

generates a socket so as to be received and processed by the DHCP server task and transmits the socket to the upper layer.

else /* a packet except the DHCP */

call an EtherRxMsg function.

(b) Send a relevant frame to a queue in the EtherRxMsg function.

(c) In a EtherRxTask function of continuously receiving and processing the frame sent to the queue in the item (b),

if(a frame type is ARP)

call an ARP processing routine (the same as the conventional routine).

else if(the frame type is an IP packet)

call a user_ip_sys function and process the frame.

(d) The processing in the user_ip_sys function plays a role of PPP header generation among functions of an HGE module in the PPP layer of the ADSL modem. Thereafter, the PPP frame is transmitted to an ATM layer so that an ATM cell can be transmitted to the NAS through asynchronous transfer mode segmentation and reassembly (ATM SAR).

(5) A data processing flow in the ADSL modem for a PPP IP packet transmitted from the NAS is performed as follows.

(a) An ATM layer of the ADSL modem sends all data frames received from the NAS to a queue to process them in the PPP layer.

(b) In a routine continuously receiving and processing the data frames sent to the queue in the item (a)

```
if(a protocol of the PPP header is a PPP IP) {
        discard an RIP packet.
        remove the PPP header (plays a role of the PPP header extraction in the
HGE module in the PPP layer of the ADSL modem).
        call a SendMsg2EtherTx function.
}
else
        process PPP negotiation (the same as that in the prior art).
```

(c) The frames are transmitted to the data link layer so that the SendMsg2EtherTx function can transmit the frames to the client PC.

(6) If the client PC is shut down, following procedures are performed.

(a) Since the client PC is shut down, the DHCP server of the ADSL modem cannot receive a DHCP-REQUEST packet from the client PC even after the predetermined time (lease time × 3).

(b) The DHCP server terminates the connected PPP session so that the NAS can withdraw the allocated global IP address.

C. Effects of the present invention

(1) A client PC can start communication right after booting of the PC without installing change and Internet access software. Thus problems that may be generated by a mis-operation or mistake of a user are removed.

(2) The NAT having its own limitation does not have to be used in an ADSL modem.

(3) Performance can be improved since the NAT causing degradation of the performance is not used in the ADSL modem. A down rate of the ADSL modem to which the present invention is applied is improved by average 33% than a conventional ADSL modem using the NAT as shown in Table 1. The test results shown in Table 1 are

simply obtained with one file, and if a long-run test is actually performed, data rate performance of the ADSL modem using the NAT is degraded while the performance of the ADSL modem according to the present invention is not changed.

Conventional method using NAT		DHCP spoofing method	
- actual link rate - down: 8.8M up: 704K		- actual link rate – down: 8.544M up: 726K	
Test 1	5.42M (down)	Test 1	7.20M (down)
Test 2	5.40M (down)	Test 2	7.12M (down)
Test 3	5.41M (down)	Test 3	7.24M (down)
Test 4	643.24K (up)	Test 4	699.09K (up)
Test 5	666.73K (up)	Test 5	701.02K (up)

Table 1: average rates tested by downloading a file size of 100M and uploading a file size of 10M

(4) A single network is configured between a NAS and the client PC. The client PC can use a global IP address and a DNS server address provided by the NAS and does not have to use a local IP address. Due to this, the user does not have to separately manage the IP addresses.

(5) Since the global IP address allocated by the NAS is withdrawn if any one of the ADSL modem and the client PC is turned off, consumption of IP addresses in the NAS is minimized.

(6) Since a DHCP server used in the ADSL modem performs the DHCP spoofing function of obtaining IP configuration information from the NAS through the PPP IPCP, an IP pool is unnecessary. Due to this, he user does not have to separately manage the IP pool of the DHCP server.

3. What is claimed is:

A. A superior concept (independent claim)

A method of performing a DHCP spoofing function in a PPPoA mode of an xDSL modem, comprising:

(1) Step 1

configuring a single network between a NAS and a client PC by performing, by an ADSL modem, PPP connection with a NAS, transmitting IP configuration information

obtained through PPP IPCP to a DHCP server of the ADSL modem, and immediately transmitting, by the DHCP server, the information to a client PC;

(2) Step 2

bridging, by the ADSL modem, IP packet transmission between the NAS and the client PC; and

(3) Step 3

when the client PC is turned off, processing, by the ADSL modem, so that the NAS can withdraw an allocated global IP address.

B. Subordinate concepts (dependent claims)

(1) The method of step 2 of the superior concept, further comprising the steps of

implementing the DHCP server, which performs the DHCP spoofing function in which the DHCP server of the ADSL modem receives the IP configuration information from the NAS through the PPP IPCP and transmits the information to the client PC; and

generating the least subnet mask, which can be configured between a global IP address and a gateway address.

(2) The method of step 2 of the superior concept, wherein

in the bridging of the IP packet transmission by the ADSL modem, an IP packet is transmitted by adding a PPP header when the IP packet transmission is performed from the NAS to the client PC and removing the PPP header when the IP packet transmission is performed from the client PC to the NAS.

4. Drawings

A. A drawing according to the prior art

FIG. 6: a protocol configuration of a conventional network using NAT in the PPPoA mode

A global IP address provided by the NAS, i.e., an ISP, is allocated as an IP address for a WAN port of an ADSL modem, and an IP address for a LAN port of the ADSL modem is a gateway IP address of a local network corresponding to a client PC. NAT converts a local IP address of the client PC in an IP packet transmitted from the client PC to the global IP address provided by the NAS and then transmits the IP packet to the NAS. The NAT also converts the global IP address in an IP packet transmitted from the NAS to the local IP address of the client PC and then transmits the IP packet to the

client PC. In addition, when the ADSL modem transmits an IP packet, PPP header information is added or removed in a PPP layer.

B. A drawing according to the present invention

FIG. 7: a protocol configuration of a network to which DHCP spoofing is applied in the PPPoA mode

An ADSL modem transmits IP configuration information received from a NAS through PPP to a DHCP server, and the DHCP server transmits the information to a DHCP client of a client PC. Then, since a single network is configured between the NAS and the client PC, the ADSL modem performs only a bridging function without a separate routing (IP address translation) process when communication is performed.

CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Priority Document with respect to the U.S Provisional patent application No. **60/316,282** filed on **September 4, 2001.**

NAME OF THE TRANSLATOR : Jong-Mi PARK

SIGNATURE : Jong-Mi Park

Date : June 23, 2005

RESIDENCE : MIHWA BLDG., 110-2, MYONGRYUN-DONG 4-GA, CHONGRO-GU, SEOUL 110-524, KOREA

CITIZENSHIP : REPUBLIC OF KOREA

PA 483361

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United States Patent and Trademark Office

October 29, 2001

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APPLICATION NUMBER: *60/316,282*
FILING DATE: *September 04, 2001*

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

N. WOODSON
Certifying Officer

Please type a plus sign (+) inside this box → +

PTO/SB/16 (8-10)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request fro filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
EUNG-SEOK	ROH	402, Kunkook Vila A-dong, #136-14, Urnan 2-dong, Paldal-gu, Suwon-shi, Kyungki-do, Republic of Korea

☐ *Additional inventors are being named on the ___ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

DYNAMIC HOST SETTING PROTOCOL SPOOFING IN THE PPP PROTOCOL USING MODE ON AN ATM OF xDSL MODEM

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☐ Customer Number [ ] → Place Customer Number Bar Code Label here

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■ Firm or Individual Name	ROBERT E. BUSHNELL & LAW FIRM				
Address	1522 K Street, NW, Suite 300				
City	Washington	State	DC	ZIP	20005
Country	U.S.A.	Telephone	(202)408-9040	Fax	(202)628-0755

ENCLOSED APPLICATION PARTS (*check all that apply*)

■ Specification *Number of Pages* 33 (In foreign language)
■ Drawing(s) *Number of Sheets* : 7
☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number ___
☐ Other (specify): ___

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (*check one*)

☐ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
■ A check or money order is enclosed to cover the filing fees (Check #40214).
☐ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 02-4943
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($)
■ $150.00
☐ $75.00

■ Foreign Filing License under 35 U.S.C. §184 is requested.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.
■ No
☐ Yes, the name of the U.S. Government agency and the Government contract number are. ___

Respectfully submitted,
SIGNATURE R E Bushnell
Date: 9/4/01
TYPE or PRINTED NAME: Robert E. Bushnell, Esq.
REGISTRATION NO.: 27,774 *(If appropriate)*
TELEPHONE: (202) 408-9040
Docket Number: P56592P

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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FEE TRANSMITTAL

Patent fees are subject to annual revision

Complete If Known	
Application Number	*To be assigned*
Filing Date	4 September 2001
First Named Inventor	EUNG-SEOK ROH
Examiner Name	*To be assigned*
Group/Art Unit	*To be assigned*
Attorney Docket No.	P56592P (Provisional Application)

TOTAL AMOUNT OF PAYMENT	($) 150.00

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to

Deposit Account Number: 02-4943
Deposit Account Number: _____

☐ Charge Any Additional Fee Required Under 37 C F R §1 16 and 1.17.

☐ Applicant claims small entity status. See 37 CFR 1.27

■ **Payment Enclosed:**
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■ Check ☐ Credit Card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	$
106	320	206	160	Design filing fee	$
107	490	207	245	Plant filing fee	$
108	710	208	355	Reissue filing fee	$
114	150	214	75	Provisional filing fee	$150 00
		SUBTOTAL (1)			($) 150.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below		Fee Paid
Total claims	-20** =		x	=	
Independent Claims	-3** =		x	=	
Multiple Dependent				=	

** or number previously paid, if greater, For Reissues, see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue Independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) .00

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge-late filing fee or oath	$
127	50	227	25	Surcharge-late provisional filing fee or cover sheet	$
139	130	139	130	Non-English specification	$
147	2,520	147	2,520	For filing a request for reexamination	$
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	$
113	1,840 *	113	1,840*	Requesting publication of SIR after Examiner action	$
115	110	215	55	Extension for reply within first month	$
116	390	216	195	Extension for reply within second month	$
117	890	217	445	Extension for reply within third month	$
118	1,390	218	695	Extension for reply within fourth month	$
128	1,890	228	945	Extension for reply within fifth month	$
119	310	219	155	Notice of Appeal	$
120	310	220	155	Filing a brief in support of an appeal	$
121	270	221	135	Request for oral hearing	$
138	1,510	138	1,510	Petition to institute a public use proceeding	$
140	110	240	55	Petition to revive - unavoidable	$
141	1,240	241	620	Petition to revive - unintentional	$
142	1,240	242	620	Utility issue fee (or reissue)	$
143	440	243	220	Design issue fee	$
144	600	244	300	Plant issue fee	$
122	130	122	130	Petitions to the Commissioner	$
123	50	123	50	Petitions related to provisional applications	$
126	240	126	240	Submission of Information Disclosure Statement	$
581	40	581	40	Recording each patent assignment per property (Times number of properties)	$
145	710	246	355	Filing a submission after final rejection (37 C F.R §1.129(a))	$
149	710	249	355	For each additional invention to be examined (37 C.F R §1 129(b))	$
Other Fee (specify) _____					$
Other Fee (specify) _____					$

** Reduced by Basic Filing Fee Paid. SUBTOTAL (3) $.00

SUBMITTED BY

Typed or Printed Name	Robert E. Bushnell, Esq.	Reg. Number	27,774
Signature	/Robert E. Bushnell/	Date	4 September 2001
Deposit Account User ID			

Complete (if applicable)

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TITLE OF THE INVENTION

DYNAMIC HOST SETTING PROTOCOL SPOOFING IN THE PPP PROTOCOL USING MODE ON AN ATM OF xDSL MODEM

1. Back ground of the invention

(A) Field of the Invention

An extended (A variety of) digital subscriber line (xDSL) is a general term to refer to all types of digital subscriber line (DSL) representing one of a symmetric digital subscriber line (ADSL), a single-line digital subscribe line (SDSL), a very high digital subscriber line (VDSL), a high-bit-rate digital subscriber line (HDSL), a universal digital subscriber line (UDSL), an integrated services digital network (ISDN) DSL (IDSL), and a rate adaptive DSL (RADSL).

The DSL connects a digital circuit network at a subscriber's site to an internet service provider (ISP) through an analog telephone line. Since the DSL provides a plurality of separate channels used for transmission of audio telephone signals, such as audio sound, fax, etc., the DSL serves high speed data communications to be transmitted and received or both the audio telephone signals and the high speed data communications to be simultaneously transmitted and received through the conventional telephone line. The DSL assigns a first frequency range of 0 kilo-Hertz (KHz) and 4KHz to the analog audio signals and a second frequency range of 4 KHz and 2.2 mega-hertz(MHz) to the data communications.

The conventional modem can not be simultaneously used for both the audio telephone signal transmission and the data communication. An integrated services digital network (ISDN) can be simultaneously used for both the audio telephone signal transmission and the data communication, but the communication and transmission speed is lowered. The xDSL, however, enables the high speed data communication along with the audio telephone signal transmission because the audio telephone signal transmission occupies the lower frequency range while the high speed data communication occupies the higher frequency range. Any crosstalk and interference is prevented, and the communication and transmission speed is not lowered.

The ADSL, one of the xDSL, denotes the symmetric digital subscriber line since the data exchanging speed between a telephone station and a subscriber is different from each other. As shown in FIG 1, the ADSL uses the downstream data channel having a wide frequency band rather than the upstream data channel. Although the communication speed is lowered three times than the CATV providing the capability of the high speed data communication having the same communication speed of the downstream data channel and the upstream data channel, the communication speed is not lowered when the number of subscribers increases. The communication speed of a subscriber using the ADSL is up to 12 megabit per second.

FIG. 1 shows the allocation of an audio telephone signal and a ADSL signal transmitted through the conventional telephone line.

(B) Description of the Prior Art

FIG. 2 shows an ADSL network using a point-to-point protocol over ATM (PPPoA) mode.

(1) Two different networks between a network access server (NAS) and the client PC.
* In GIG 2, There exists a public network (200.0.0.0) between the NAS and the ADSL modem and a private network (10.0.0.0) between Client PC and the ADSL modem.

(2) A network Address Translation (NAT) is used for an internet protocol (IP) address and an IP global address on the ADSL modem.

(3) The IP address and a gateway IP address are brought to the ADSL modem and are set as WAN (LAN?:local area network) port information after the ADSL modem is PPP-connected to the NAS through PPP layer on the ADSL modem.

(4) A user should input into the client PC a local IP address and a subnet MASK as IP configuration information, and a ADSL modem's local IP address and a domain name service (DNS) server Address as a gateway IP address.

(5) When the client PC communicates with the NAS, the IP address is routed along (translated through) the ADSL modem to the NAT.

(C) Problems of the Prior Art and Objects of the Present Invention

- Problems of the prior art

(1) The NAT is used for routing the two different networks between the NAS and the client PC on the ADSL. Therefore, there exist the following limitations on the NAT as described in RFC1631.

(a) The performance decreases in response to the increase of the number of NAT table.
(b) The possibility of mis-leading increases.
(c) The problems in using a particular application having the IP address on IP packet payload occur when the NAT is used.

(d) The negative effects occurs although the privacy is maintained by hiding the HOST identity.
(e) Some problems on SNMP and DNS.

(2) Even if a user's PC is turned off, during the user's ADSL is in the state of power on, the NAS can neither withdraw the global IP address which was assigned to the user nor assign to another user the global IP address.

(3) The user should reset the IP configuration, such as the IP address, the gateway address, the subnet mask, and the DNS server address, at least once(?).

(4) If the ISP provides an PPP over Ethernet (PPPoE), which does not have the above three problems as mentioned above, in the PPPoA mode, the following problems occur.

(a) The user needs to install internet connection software having PPPoE driver in the user's computer.
(b) The ISP and the user additionally pay for the internet connection software.
(c) The user should reinstall the software in the user's computer when the private files and the public files for the internet connection software are deleted.
(d) Even if reinstalled, the public files used in the internet connection software has shown the conflict problems with other applications. Therefore, the problems burden the ISP with after-services for removing the conflict problems from the software.
(e) The user's PC needs to allocate resources within the PC for the internet connection software, and the internet connection software is loaded before the internet connection.
(f) The user needs to keep the ID and the password for the internet connection software confidential with the user's risk. The ID and the password may be exposed to any user of the PC.

-Objects of the Present Invention

(1) The NAT which is used for routing the other different network, is removed from the ADSL modem. In order to form a single network between the NAS and the client PC, the global IP address and the gateway IP address, which is obtained when the ADSL modem is PPP-connected to the NAS, is transferred from the ADSL to the client PC. A dynamic host configuration protocol (DHCP) server is implemented into the ADSL modem.

(2) The ADSL modem transfers data between the NAS and the client PC using a bridge

formed between the NAS and Client PC. The ADSL is improved in performance.

(3) The DHCP of the ADSL modem acts as a server with respect to the DHCP client contained in the operating system of the client PC. It is advantageous that the user does not have to directly reset the IP configuration.

(4) The client PC does not need to additionally have the IP address because the global IP address obtained from the NAS is used in the client PC.

(5) IF one of the ADSL modem and the client PC is turned off, the global address, which is assigned by the NAS, is withdrawn from the ADSL or the client PC. The number of global IP address issued from the NAS is reduced.

2. Detail Description of the Present Invention

A. brief description of the reference numerals

FIG 3 shows a protocol structure and a data flow in the ADSL modem.

DHCP -- Dynamic Host Configuration Protocol
HGE – Header Generation/Extraction
AUTH – Authentication
ATM – Asynchronous Transfer Mode
IP – Internet Protocol
LLC – Logical Link Control
ARPI – Address Resolution Protocol
NSM – Negotiation State Machine
LCP – Link Control Protocol
IPCP – Internet Protocol Control Protocol
UDP – User Datagram Protocol
PPP – Point-to-Point Protocol
MAC – Media Access Control
AAL –ATM Adaption Layer

The present invention removes the NAT as shown in FIG 3. Instead, the DHCP is added. The IP configuration, which is needed in the client PC, is transferred to the DHCP server on the conventional PPP layer. The HGE is added to remove a PPP header because the PPP communication for transferring IP packet in the ADSL modem is performed between the NAS and the ADSL modem.

B. Detail Description of the invention

FIG 4 shows a network structure of the ADSL modem using DHCP spoofing in the PPPoA mode.

A single network is formed between the NAS and the client PC because the global IP address obtained from the NAS is transferred to the client PC through the PPP IPCP of the

ADSL. (In FIG 4, there exists a public network (200.0.0.0) between the NAS and the client PC.) When booted, the client PC broadcasts DHCP-Discover Packets to the network to locate a DHCP server of the ADSL modem in response to the activation of the DHCP client of the client PC. When the DHCP server of the ADSL modem receiving the DHCP-Discover Packets operates a PPP session to be opened to both the NSA and the ADSL modem and obtains from the PPP IPCP the IP configuration information, such as the global IP address, the gateway IP address, and the DNS Server address. The ADSL modem sends the DHCP client of the client a subnet mask packeted into a DHCP-Offer and a DHCP-ACK packet along with the IP configuration information received from the NAS. The DHCP client of the client PC set the IP configuration information into the client PC in response to the DHCP-ACK. Since the single network is formed between the NAS and the client PC by setting the IP configuration information into the client PC, the bridging operation performs without an additional routing process of the ADSL modem during the communication between the client PC and the NAS. If there is no DHCP-REQUEST from the client PC to renew a lease time of the global IP address during a predetermined period of time (lease time X 3), the DHCP server terminates the PPP-session connected to the client PC and withdraws the Global IP address from the client PC. Each step of the detail process is described as follows.

(1) When the ADSL modem is booted, the DHCP is ready to provide a service.

(2) After the client PC is booted, the following operations perform.

(a) The DHCP client contained in the operation system of the client PC is activated and broadcasts a DHCP-Discover packet to seek the DHCP server of ADSL modem.

(b) the DHCP server of the ADSL modem activates the process for opening the PPP session between the NAS and the ADSL modem in response to the receipt of the DHCP-Discover.

(c) After the PPP session is connected, the PPPIPCP obtains the IP configuration information including the IP address, the gateway IP address, and the DNS server address, all of which are used in the client PC. Although the algorism and flow for processing the PPP IPCP utilizes the conventional system, the IPCP option 81(primary0DNS-address) and the IPCP option 83 (secondary-DNS-address) are added to the system when the ADSL sends the NAS a configuration-request. The NAS responds to the ADSL and processes the configuration-request. The configuration IP information received from the NAS is as follows.

- Local IP address: a global address assigned to the client PC by the NAS.
- Remote IP address: the IP address with which the client PC corresponds to the NAS

having the gateway IP address.

– DNS Server address: The ADSL modem requests the NAS to send the ADSL both a primary-DNS-address and a secondary-DNS -address. If the ADSL can not receive the primary-DNS-address and the secondary-DNS -address from the NAS because the NAS is not set to issue the primary-DNS-address and a secondary-DNS -address, the DNS Server address stored in a flash memory is used as the DNS server address.

(d) In the above item (1), the PPP IPCP transfers the IP configuration information to the DHCP server.

(e) The DHCP server of the ADSL transfers to the client PC the related information of the IP configuration information including the Default address of the ADSL modem through the DHCP-Offer packet in response to the DHCP-Discover.

The packet transferred to the client PC includes the followings.

- the global address, the gateway address, and the DNS server address obtained from the NAS.
- values for lease time and lease renewal time. (A period of 5 seconds is reasonable for promptly applying the values of the above item(c) in the client PC according to the test result.)
- a minimum value of the subnet mask assembled from the gateway IP address and the global IP address.

```
for (int n_count 31: n_count >0; n_count –) {
        If (Global_IP Address >>n-count) !=(Gatewqy_IP Address >> n_count)){
                n_count ++;
                Break;
        }
}
subMask = (OxFFFFFFFF >> n_count);
subMask = (subMask << n_count);
```

-------- a routine for producing a subset mask ----------

(f) The client PC broadcasts the DHCP-Request in response to the DHCP-Offer packet.

(g) In response to the DHCP-request, the DHCP server of the ADSL modem send the unicast Ethernet address of the client PC the IP configuration information which has been obtained in the above step (e) and is loaded in the DHCP-ACK packet.

(h) The DHCP client of the client PC installs the IP configuration information into the client PC in response to the DHCP-ACk packet.

(i) The ARP process along with the above message processing steps is similar to the conventional process, and the DHCP message process performs in accordance with the RFC2131.

- ARP process:
    if (packet is ARP request about gateway)
        ARP reply sending
        (Make packet: PC gateway IP and board hardware address mapping)
-DHCP message process:
    FIG 5 shows a flow for processing the DHCP message.

(j) The DHCP client of the client PC sends a DHCP-Request packet to Default IP address of the ADSL modem to obtain a new lease time after the lease renewal time passed.

(k) In response to the DHCP Request packet from the DHCP client of the client PC, the DHCP server of the ADSL modem sends the DHCPACK packet, which is similar to the DHCP ACK packet of the above step (g), to the unicast Ethernet address corresponding to the client PC.

(3) The following flow shows the processing of the DHCP packet in the ADSL modem corresponding to the above described item(2).

(a) In a routine processing all the frames received from the client PC in the LLC, a data link layer of the ADSL modem,

if it is the DHCP packet,
an upper layer is loaded to the DHCP packet as a socket to allow the DHCP server task to receive and process the DHCP packet.

else
IP packet processing is performed.

(b) In a routine processing the socket in the DHCP server task, a predetermined processing routine is chosen depending on a message type. A received packet is the DHCP data packet excluding an IP header and a UPD header.

(Examples)
- If it is the DHCP-Discover packet, a discover function for making and sending out the DHCP-OFFER packet is cited.
- If it is the DHCP-Request packet, a request function for making and sending out the DHCP-ACK or the DHCP-NAK packet is cited.

(c) In a function for sending the DHCP packet,

- the UDP and the IP address are added. The IP address is the Default IP address of the ADSL modem.
- The packet is made in data link layer and ready to be transferred to the client PC.

(4) The data processing flow in the ADSL modem in response to the IP packet transmitted from the client PC is described as follows.

(a) In the routine processing all the frames received from the client PC in the Data link layer of the ADSL modem,

whether it is the DHCP packet is checked.
- the packet is loaded to an upper layer to allow the DHCP server task to receive and process the packet as a socket.

else /* the packet other than the DHCP*/
An Ether RxMsg function is cited.

(b) In the Ether RxMsg function, the corresponding frame is sent as a queue.

(c) In the Ether RxMsg function receiving and processing the frame inserted in the queue of the above step(b),

if the frame type is the ARP, the ARP processing routine is cited.

else if the frame type is the IP packet, a user_ip_sys function is cited to process the frame.

(d) The user_ip_sys function as a function of the HGE module of the PPP layer of the ADSL modem, generates the PPP header. The PPP frame is transmitted to the ATM layer to send the ATM cell to the NAS through the ATM SAR.

(5) The data processing flow in the ADSL modem in response to the Ip packet transmitted from the NAS is described as follows.

(a) A queue is sent to process in the PPP layer all the data frame received from the NAS in the ATM layer of the ADSL modem.

(b) In a routine of receiving in the PPP layer and processing the data frame inserted into the queue as described in the above step (a),

If the protocol of the PPP header is the PPP IP,
The RIP packet is discarded.
The PPP header is removed. (as an extraction function of the PPP header in HGE module in the PPP layer of the ADSL modem.
The Send Msg2Ether Tx function is cited.

else
PPP negotiation is performed as the conventional system does.

(c) The frame is transmitted to the data link layer to send the frame to te client PC in the SendMsg2Ether Tx function.

(6) The following process is performed when the client PC is shut down.

(a) The DHCP sever client can not receive the DHCP-Request packet from the client PC during a predetermined period of time (Lease_time X 3) because the client PC is shut-down.
(b) The DHCP server terminates the PPP session connected to the client PC and withdraw the global IP address assigned to the client PC.

C. Effects and Merits of the Present Invention

(1) After booted, the client PC is connected to the internet without changing and installing internet connection software. All problems caused by the user's mishandling and mistaking of the client PC are removed.

(2) The ADSL modem does not need the network address translation (NAT) having limitations.

(3) because the NAT is not used in the ADSL modem, the ADSL is improved in its performance. The ADSL constructed according to the principles of the present invention shows down and up (load) speeds which are improved by about 33% compared to the conventional ADSL having the NAT as shown in table 1. The test result of the table 1 represents the uploading and downloading speeds of a single file. Although the performance of the downloading and uploading speeds in the conventional ADSL modem having the NAT is lowered in a long-run test, the ADSL modem constructed according to the present invention does not show any change of the performance of the downloading and uploading speeds.

	The conventional method using the NAT invention -Actual Link Rate- Down:8.8M Up:704K	The DHCP Spoofing method of the present -Actual Link Rate- Down:8.54M Up:726K
TEST 1	5.42M (Down)	7.20M (Down)
TEST 2	5.40M (Down)	7.12M (Down)
TEST 3	5.41M (Down)	7.24M (Down)
TEST 4	643.24K (Up)	699.09K (Up)
TEST 5	666.73K (Up)	701.02K (Up)

[Table 1. The average speed of the test result when a file having 100M in size is downloaded, and when another file having 10M in size.]

(4) A single network is formed between the NAS and the client PC. Since the client PC is able to use the global IP address and the DNS server Address provided by the NAS, any other additional local IP address is not needed. Therefore, the user does not have to manage any other additional IP address.

(5) The global IP address is withdrawn when any one of the ADSL modem and the client modem is turned off. Therefore, the number of global IP addresses issued by the NAS decreases.

(6) The DHCP server of the ADSL modem does not need the IP Pool because the DHCP server performs a DHCP spoofing function for obtaining the IP configuration information from the NAS through PPP IPCP. Therefore, the user does not have to manage the IP Pool of the DHCP server.

What is claimed is:

1.Upper concept (Independent claims)

A method of a DHCP spoofing function including a first step, a second step, and a third step in a PPPoA mode in a xDSL modem.

(A) the first step of forming a single network between the client PC and a NAS by allowing the ADSL to make a PPP connection to the NAS when the client PC is booted, by allowing the NAS to transmit the IP configuration information ot a DHCP server of the ADSL modem through a PPP IPCP, by allowing the ADSL to transfer the IP configuration information received from the NAS to the client PC.

(B) the second step of allowing the ADSL modem to bridge and the transfer the IP packet between the client PC.

(C) the third step of allowing the NAS to withdraw the global IP address assigned to the client PC when one of the client PC and the ADSL modem is turned off.

2. Lower concept (dependent claims)

(A) In the second (first) step of allowing the DHCP server of the ADSL modem to perform a DHCP spoofing function providing the client PC with the Ip configuration information through PPP IPCP from the NAS and of producing a minimum subnet mask consisting between the global IP address and the gateway address. .

(B) In the second step of allowing the NAS to add a PPP header when the IP packet is transferred from the NAS to the client PC and of allowing the ADSL modem to delete the PPP header from the IP packet when the IP packet is transferred from the client PC to the NAS.

4. Drawings

(A) A drawing for a conventional system.

FIG 6 shows a protocol structure of the conventional network using the NAT in a PPPoA mode.

The global IP address provided by the NAS or the ISP is assigned as an IP address for WAN(LAN?) port of the ADSL modem. The IP address for the LAN port becomes the gateway IP address of local network same as the client PC. After the local IP address of the client PC obtained from the IP packet transmitted into the client PC is changed to the global IP address, the NAT transmits the global IP address to the NAS. The global IP address obtained from the IP packet transmitted from the NAS is changed to the local IP address of the client PC, the local IP address is transmitted to the client PC. The ADSL modem adds the PPP header information to the IP packet and remove the PPP header information from the IP packet when the IP packet is transferred between the client PC and the NAS.

(B) A drawing for the present invention.

FIG 7 shows a protocol structure of the network constructed according to the principles of the present invention using a DHCP spoofing function in the PPPoA mode.

The IP configuration information obtained from the NAS through PPP connection is transferred to the DHCP server in the ADSL modem. The DHCP server transmits the IP configuration information to the client PC. Since the single network forms between the client PC and the NAS, the conventional routing process(IP address translation) is not needed in the ADSL modem during communication between the client PC and the NAS, but the bridging unction is performed..

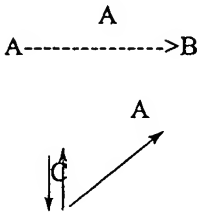
(Page 1) DHCP Spoofing on PPP over ATM mode in xDSL Modem

Home G/W development

Eung-Seok ROH (Inventor's name)

(Page 2) Spoofing ?

A host transmits packets to a receiver by hoaxing the receiver that the packets are sent by another host.



(Page 3) DHCP Spoofing?

- IP configuration information of a network is needed to be connected to the Internet

- The xDSL obtains from the ISP the IP configuration information of the network.

PC ----- ADSL modem ----------ISP ----------Internet network

(Page 4) DHCP Spoofing?

- The DHCP Spoofing transfers the IP configuration information obtained from the ISP to the client PC.

ADSL Modem
PC ----------ISP ----------Internet network

- the client PC is directly connected to the ISP to obtain the IP configuration information, and the modem (of the client PC or of ADSL modem?) operates to communicate with the ISP.

(Page 5) An ADSL network structure using the conventional PPPoA mode

Global IP: 200.0.0.10
Gateway IP:200.0.0.1
Local IP:10.0.0.10 Global IP: 200.0.0.1

Client PC – (private network) -- ADSL modem – DSLAM (public network) – NAS – Internet network

Local IP: 10.0.0.100
Gateway IP: 10.0.0.10
Subnet Mask: 255.255.255.0
NDS Server: 165.213.221.4
203.241.132.34

- DSLAM (Digital Subscriber Line Access Multiplexer)
- NAS (Network Access Server: ISP)
-PPPoA: Point-to-Point Protocol over ATM

(Page 6) The protocol stack of the conventional network using the NAT in the PPPoA mode

Application					Application
TCP			NAT		TCP
IP(Global)			IP(Global)	IP(Local)	IP(Local)
PPP			PPP	LLC	LLC
ATM	ATM		ATM	MAC	MAC
<-------STM-1---->		<------ ADSL---------->		<---------- Ethernet ---------->	
NAS	DSLAM		ADSL Modem		Client PC

(Page 7) Disadvantage in the prior ART (1)

- Limitations of the NAT (RFC1631)

  - The NAT table increases. ----> the performance of the NAT decreases.

  - The possibility of mis-addressing increases.

  - A particular application occurs problems by entering an IP address of a Payload of an IP packet.

  - The host's identity is hidden. --> Negative effects occurs in spite of the privacy of the host.

  - There are some problems in SNMP and the DNS.

(Page 8) Disadvantage in the prior ART (2)

- The Global IP addresses issued by the NAS are consumed too much.

- It is disadvantageous that the IP configuration information is manually set in the client PC.

- There exist some problems in the PPPoE mode which eliminates the defects of PPPoA mode.

(Page 9) Defects in the PPPoE

- The Internet connection software should be installed in the client PC.
- The additional expense occurs.
- If deleted, the related structure and public files are reinstalled.
- There exist possibilities that one application conflicts with another application.
- The Internet connection software must be loaded for the Internet connection.
- The user ID and the password of the client PC can be exposed to other users.

(Page 10) Objects of the Present Invention

- The NAT is eliminated.
- The operation of bridging —> The Improvement of the performance.
- Very convenient that the user does not have to manually install the IP configuration in the client PC.
- No need to form the local network because the global Ip address is used in the client PC.
- Minimization of the number of global IP address.

(Page 11) ADSL network formation for DHCP Spoofing in PPPoA

Global IP: 200.0.0.10
Gateway IP:200.0.0.1
Subnet Mask: 255.255.255.0
NDS Server: 165.213.221.4
203.241.132.34

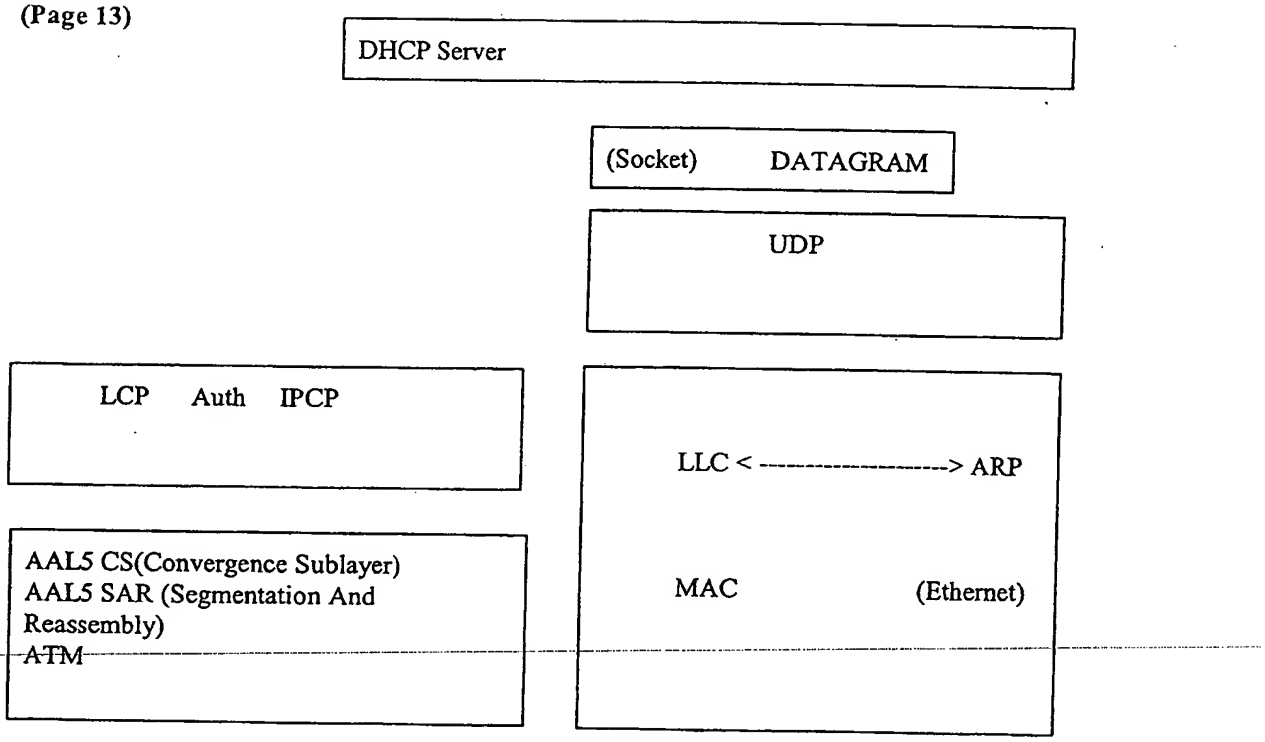
<---------- Public network ---------->Global IP: 200.0.0.1

Client ---------- ADSL ------ DSLAM ---------- NAS ---------- Internet network
PC modem

(Page 12) Protocol Stack of the DHCP Spoofing network in PPPoA mode

Application		DHCP Server		Application
TCP			UDP	TCP
IP(Global)			IP	IP(Globall)
PPP		PPP	LLC	LLC
ATM	ATM	ATM	MAC	MAC
<-------STM-1---->		<------ ADSL---------->	<---------- Ethernet ---------->	
NAS	DSLAM	ADSL Modem		Client PC

(Page 13)



(Page 14) IP Configuration information transmitted from the NAS

- Node IP address
- Gateway IP address

- DNS Server address

(Page 15) IP configuration information used in the client PC

- Node IP address
- Gateway IP address
- DNS Server address
- Subnet Mask which is provided by the ADSL modem to the client PC.

(Page 16) Conventional method of extracting the Subnet Mask

- using the Subnet Mask corresponding to a class of the IP address.

  - 120.100.10.20 (Class A) –> 255.0.0.0
  - 168.219.81.20 (Class B) –> 255.255.0.0
  - 210.100.30.20 (Class C) –> 255.255.255.0

(Page 17) Problems of the conventional method of extracting the Subnet Mask

- The Subnet Mask is not identical to the original one by sub-netting the class of the IP address provided by the ISP. 255.255.255.0 is obtained by sub-netting 168.219.81.20(Class B) into Class C.

- The Subnet Mask is not identical even by super-netting as well as Variable length sub-netting.

(Page 18) Idea for producing the Dynamic Subnet Mask

- Using a node IP address and a gate IP address provided by the ISP.

- Producing a minimum Subnet Mask existing between the node IP address and the gateway IP address.

- 225.225.225.224 is obtained when the gateway address is 168.219.82.240 and when the node IP address is 168.219.82.226.

(Page 19) Principles for producing the dynamic Subnet Mask

168.219.82.226	1010100	1101101	1010010	1110001
	0	1		0
168.219.82.240	1010100	1101101	1010010	1111000
	0	1		0

---------->

- Setting to the minimum Subnet the value at the first different values during comparing values in the direction from the most significant bit to the least significant bit.

(Page 20) Algorism fo producing the Subnet Mask

```
for (int n_count 31; n_count >0; n_count --) {
        If ( (Global_IP Address >>n-count) !=
                        (Gateway_IP Address >> n_count))
        {
                n_count ++;
                Break;
        }
}
        subMask = (OxFFFFFFFF >> n_count);
        subMask = (subMask << n_count);
```

(Page 21) Effects of the Present Invention (1)

- The average 33 % increase in the performance

	The conventional method using the NAT -Actual Link Rate- Down:8.8M Up:704K	The DHCP Spoofing method -Actual Link Rate- Down:8.54M Up:726K
TEST 1	5.42M (Down)	7.20M (Down)
TEST 2	5.40M (Down)	7.12M (Down)
TEST 3	5.41M (Down)	7.24M (Down)
TEST 4	643.24K (Up)	699.09K (Up)
TEST 5	666.73K (Up)	701.02K (Up)

[The average speed for downloading 100M in full size and for uploading 10M in full size]

(Page 22) Effects of the Present Invention

- No need of the NAT

- Eliminating problems occurred by the user's mistake and mishandling

-No need for the user to manage the IP address

-Minimizing the number of the issued Global IP address.

- No need to manage the IP Pool in the DHCP Server